ADAPT-HERD

Management strategies to improve herd resilience and efficiency by harnessing the adaptive capacities of small ruminants

PRIMA section 2 project

Deliverable 3.1

Characteristics of production systems using sheep and goat local breeds (report)

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Concerned work package leader: Margalida Joy (CITA)

Dissemination level: Public

CHARACTERIZATION OF THE PRODUCTION SYSTEMS: FEEDING RESOURCES, MANAGEMENT RULES AND TYPE OF MARKETABLE PRODUCTS

(REPORT D3.1)

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1. Introduction

Small ruminants have an important adaptive capacity to deal with constraining and fluctuating environmental conditions, especially regarding feeding resources. This capacity is called upon under Mediterranean conditions, because of the large, and not always predictable, variations in feed resources and environment conditions throughout the year. This condition involves to a constant adaptation of the flock management to the current environmental conditions at all times in order to achieve an optimum production. Managing reproduction, tailoring group feeding strategies based both on pasture and supplementation, and managing herd demography must be continually assessed to find the best match between feed supply and herd demand. Farmers are motivated to harness animals' adaptive capacities to face feed shortage, and/or extreme temperatures, combining with the animal productive level, and the quality of the sold product (milk, meat…). Thus, adaptive capacities should be fully integrated within management strategies of the small ruminant farm. One overriding aim of ADAPTHERD is to assess the adequate management strategies, considering adaptive capacity, to match feed supply and animal / herd demand during the productive cycle. The adaptive capacity of herd to face resource shortage or extreme temperatures must be evaluated to reduce the inputs and to adapt the flock, size, and management, to the feed availability and temporal distribution. To reach this objective, the characterization of the production systems is needed and the task 3.1 of WP3 is responsible to achieve it. This information will contribute to develop herd simulation models representative in a local context (WP4).

2. Methodology

The research was carried out in four Mediterranean countries, Egypt, Spain, Tunisia, and France through a survey.

2.1. Define typical production systems and survey to collect data

Each country defined the typical production systems located in their geographical areas. The final systems to evaluate were:

Egypt: Extensive, Intensive and Semi-Intensive.

Spain: Dryland, Irrigated and Mountain.

Tunisia: Agro-pastoral, Agro-pastoral irrigated, Agro-sylvo-pastoral and fatteners.

France: PlainHills and PreAlps.

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The survey was developed by the CITA team and consensual with the rest of the teams involved in the project. In addition, CITA developed a training session with Egypt, Tunisia and France in order to explain well the survey and the database to collect homogeneously the data.

The questionnaire (presented in Annex 1) gathered information about the following:

1) Family and labour.

We recorded the family size dived by ages and we asked about the generation turnover and de composition of the workforce. The work unit (WU) was calculated as: WU= (((280*Months/year)/9.205479452)*Hours/day)/2920.

2) Land use.

In this section we recorded the Utilised Agricultural Area (UAA), for the calculation of it we have consider the permanent, cereal and forage crops in Egypt, Spain, and Tunisia. In France, to calculate the UAA it has been considered also the rangeland and permanent pasture.

The common lands have been also presented, in these lands, pastures areas that are not belong to the above crops mentioned has been included in the total land available. Many of the farms did not know the ha of the common land, so this data must be considered with caution.

3) Flock

We recorded the flock size (number of adult ewes, replacement ewes and rams) and calculated the replacement rate as:

$$replacement\ rate = \frac{replacement\ ewes}{adult\ ewes + replacement\ ewes}$$

The breed of ewes and the number of each one was recorded, as well as the source of females and males with the percentage that they obtained from their own flock, bought or both (own and bought).

We recorded other species in some farms as goats, camels, cattle and pigs.

The livestock unit (LU) was calculated per specie. Livestock units conversion factors applied were: 1 for cattle and camel, 0.15 for both female sheep and goats, 0.10 for replacement females and 0.12 for males. Regarding pigs, 0.12 for pigs between 20-100 kg was used.

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The different species are presented in percentage of farms that have it and in the percentage of the total number of livestock units they represent.

Several indexes were calculated indicating the intensity of the systems.

$$Sheep\ land\ use = \frac{Livestock\ unit\ of\ sheep}{UAA\ (ha)}$$

$$Sheep\ land\ use = \frac{Livestock\ unit\ of\ sheep}{total\ land\ avalaible\ (ha)}$$

$$Sheep\ labour\ use = \frac{Livestock\ unit\ of\ sheep}{total\ work\ unit}$$

The land use was calculated with the Utilized agricultural area, and also with the total land available considering the common lands and pastures areas.

In addition, these indexes were calculated with sheep+goat LU, as they are usually management in the same flock. Regarding

4) Reproductive management

In the reproductive section, we registered the lambing systems, asking if they were continuous, 1 lambing at year, 3 lambing in two years or 5 lambing in three years.

Then, we asked about some activities related the reproduction as if they used male effect, hormonal treatment, artificial insemination, pregnancy diagnosis and, if they belong to a breeding program providing data. We also asked the age at the first lambing and finally the lambing calendar divided in seasons.

The following reproductive indexes were calculated as:

$$Fertility = \frac{number\ of\ lambing\ per\ year}{number\ of\ ewes}$$

$$Prolificacy = \frac{number\ of\ lambs\ born}{number\ of\ lambings}$$

$$Productivity = \frac{number\ of\ lambs\ sold}{number\ of\ ewes}$$

$$Lambs\ mortality = \frac{number\ of\ lambs\ born}{number\ of\ lambs\ died}$$

5) Feeding management

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The feeding management were asked, separately for ewes and lambs. Grazing days and type of grazing were recorded.

The supplementation was divided in three types: energy when the supplement was cereal or concentrate, fiber when the supplement was forage (straw, hay…) or the combination of the two (energy+fiber).

6) <u>Lamb sales</u>

We asked about the selling criteria if it was by age, weight or both, and then the category of the lambs sold that we divided in suckled (lambs fed exclusively maternal milk and slaughter with approximately 35 days old), light lambs (<26kg of body weight) and heavy lambs (>26kg of body weight).

2.2 Area of study

2.2.1 Area of study in Egypt

Three areas were selected in Egypt that are represented in the Figure 1. The Coastal Zone of Western Desert (CZWD) that is characterized to be a rain fed area with extensive systems based on grazing. The second area is the Upper Egypt (UE), that is characterized to have an irrigation system from the Nile river canals with intensive agriculture and mixed crop-livestock production system. And the last area the Desert Oasis (NV) with an irrigation system from springs from ground water and a Semi-Intensive system.
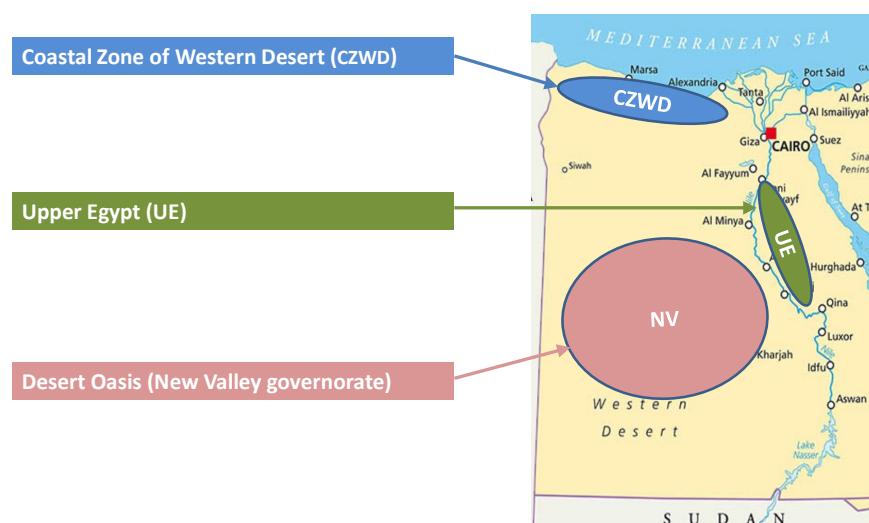
Figure 1: Location of the surveys developed in Egypt.

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The climatic condition varied among locations, presenting in general low annual rainfall (Table 1) with the maximum average of 140 mm in Coastal Zone and the minimum of 8 mm in New Valley (Desert Oasis).

Table 1: Climatic conditions of Coastal zone of Western Desert (CZWD), Upper Egypt (UE) and Desert Oasis (NV).

	CZWD	UE	NV
Annual rainfall	< 140mm	10-15 mm	8 mm
Ambient temperature	19-38°C	17-47°C	18-47°C

2.2.2 Area of study in Spain

The three systems selected in Spain are in Aragón (Figure 2), a region in the north-eastern Spain. The **Mountain system** is in the north, near the Pyrenees, that is the natural border between Spain and France. The climate in this region presented annual precipitation of 922 liters and the annual mean temperature is 9 degrees. The **Irrigated and Dryland systems** are in the Ebro valley, near Zaragoza. The climate is similar in both systems, with 431 liters of annual precipitation and 15 degrees of annual temperature. The main difference between these systems is the irrigation, that is only available in the Irrigated system.

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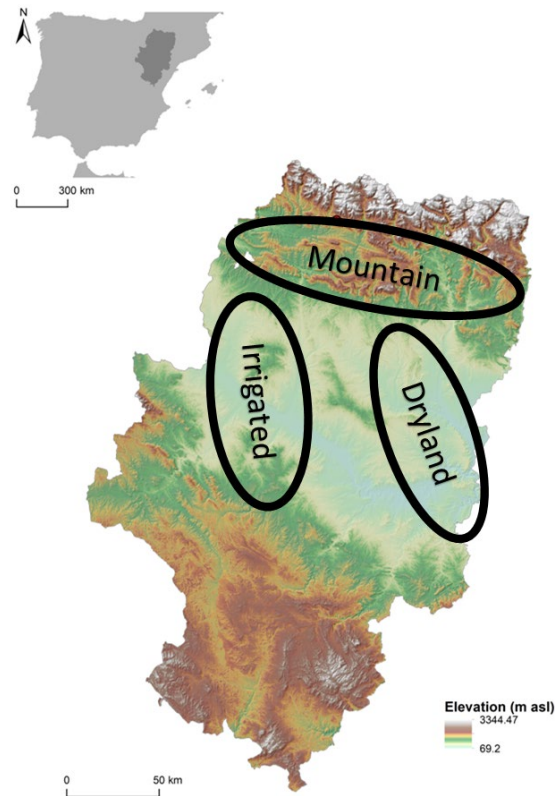
Figure 2: Location of the surveys developed in Spain.

2.2.3 Area of Study in Tunisia

The area of Tunisia selected was the semi-arid bioclimatic zone, in the north of the country. It is represented in the Figure 3 in clear blue colour. The annual precipitation of the last years was 418 l/m^2 and the annual mean temperature 18ºC.

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Figure 3: Location of the surveys developed in Tunisia

2.2.3 Area of Study in France
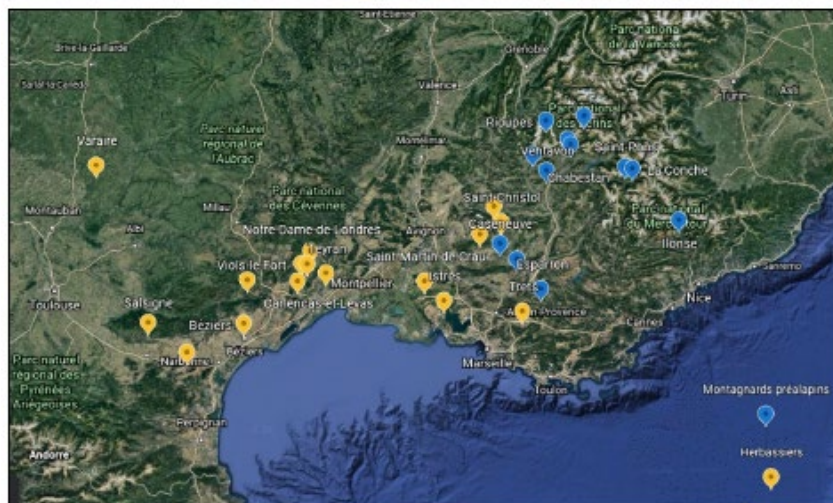
Figure 4: Location of the surveys developed in France, in PlainHills and PreAlps areas.

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The two systems selected in France are in Occitanie and PACA, two regions in the south of France. **The Plain Hills systems** are located across Mediterranean Sea. The climate in this region presented annual precipitation of 753 liters and the annual mean temperature is 13 degrees. **The PreAlps systems** are in the PACA region. The climate in this region presented annual precipitation of 1,036 liters and the annual mean temperature is 9 degrees

3. Results

3.1 Egypt

Egypt team conducted a total of 45 surveys, divided in three systems: 17 in extensive system, 15 in intensive system and 15 in Semi-Intensive system.

3.1.1 Family and Labour

Table 2 shows the data collected about family size, continuity, and workforce composition by farming system in Egypt. The Extensive system presented the greatest family size with an average of 22.9 members, whereas the Intensive and Semi-Intensive systems presented on average 8.6 and 14 family members respectively. In all systems the young family members (under 18 years) represents a high proportion of the family members (46.7%, 34.9%, and 45.7% for Extensive, Intensive, and Semi-Intensive , respectively).

The 94% of the farms from Extensive system had a family member who will replace the current person in charge of the farm when he retires. Generation turn over in the intensive area is 100%, and only 67% in the semi intensive

Regarding the labour, the Extensive was the system with highest number of WU (4.7), whereas the Intensive and Semi-Intensive presented lower WU (≈2) and in both systems the family labour supposed 85 and 90% (Intensive and Semi-Intensive, respectively), while the Extensive supposed 70%. Therefore, the Extensive system presented the greatest amount of WU and the greater percentage of hired labour.

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Table 2: Results related to Family and labour aspects obtained from Egypt.

Farming System	Extensive	Intensive	Semi-Intensive
Family members	22.6	8.6	14.0
Age > 65 years	1.2	0.3	1.1
Age 65-18 years	10.9	5.3	6.5
Age < 18 years	10.5	3.0	6.4
Farmer's age	48	49	41
Continuity			
Yes	94%	100%	67%
No	6%	0%	33%
not known	0%	0%	0%
Labour			
Family labour, WU	2.7	1.5	1.7
Hired labour, WU	2.0	0.2	0.5
Total labour, WU	4.7	1.7	2.2
Family labour,%	70%	90%	85%

NA= Not answer; WU= Work unit

3.1.2 Land Use

The land use in Egypt is presented in Table 3.

The Intensive and Semi-Intensive system presented a noticeable lower utilized agriculture area (UAA) with 1.1 and 2.9 ha, respectively, whereas the extensive system had 25 ha UAA. The UAA was composed by permanent crops (olive, fig, almond, palm…), cereal crops (wheat, corn, barley), and forage crops. Common lands include all pasture area that did not belong to any of the above cited crop. In Extensive system, all farms use common lands, with a surface of 67 ha as average. Intensive doesn't use any common lands, and in Semi-Intensive system, 73% of farms use common lands, although only represent an average of 2 ha. The 78% of the UAA available is owned in the Extensive system, and 51 and 55% in Intensive and Semi-Intensive systems, respectively.

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Regarding the irrigation, the Intensive presented the greatest percentage of farms having 100% irrigation followed by semi-intensive (85% of the UAA), whereas the Extensive system did not present irrigation.

Table 3: Results related to Land Use aspects obtained from the Egypt's surveys

Farming System	Extensive	Intensive	Semi-Intensive
Utilised Agricultural Area (UAA) (ha)	25	1.1	2.9
Permanent crops, ha	7.5	0	0.2
Cereal crops,ha	17.5	0.5	1.3
Forage crops, ha	0.0	0.6	1.4
Owned, % UAA	79%	51%	55%
Irrigated, % UAA	0%	100	85%
Use of common lands, % farms	100%	0%	73%
Common lands, ha	67	0	2
Total land available (ha)	91.7	1.1	5.2

3.1.3 Flock

The flock size, the replacement rate and the breeds used in Egypt are presented in Table 4. Regarding the flock size, the Semi-Intensive system presented the smallest flock (13 adult ewes) with the greatest ratio of replacement (30%). In contrast, the Extensive system presented the biggest flock with 211 reproductive ewes and the lowest ratio of replacement (15%). The main breed used was Barki in Extensive system and Baladi inIntensive and Wahati in the semi -Intensive systems. None of the farmers of Intensive and Semi-Intensive systems were members of a breeders' association, whereas in Extensive system all the farmers are members, in agriculture or livestock associations, which is needed to get credits for feed stuffs and agriculture inputs.

The percentage of farms that the source of females or males are from the own farm range from 60 to 82 % in females and 36 to 67 % in males, whereas the rest of the farms share both sources for female. A low percentage of farms of Intensive and Semi Intensive system buy the males (7 and 14%) (Table 4).

Table 4: Results related to characteristic of Flock obtained from the Egypt's surveys

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Farming System	Extensive	Intensive	Semi-Intensive
Sheep Flock			
adult ewes, n	211	22	13
adult rams, n	30	8	5
replacement ewes, n	10	2	1
Replacement rate,%	15%	26%	30%
Sheep breed			
Baladi, %	0%	100%	0%
Barki, %	100%	0%	0%
Wahati, %	0%	0%	100%
member of a breeders' association,(% farm)	38%	0%	0%
provider of data, % farm	0%	0%	0%
Flock source ewes, % farms			
Own	82%	60%	67%
Bought	0%	0%	0%
Both	18%	40%	33%
Flock source rams, % farms			
Own	47%	67%	36%
Bought	0%	7%	14%
Both	53%	27%	50%
Mixed-species farms	94%	100%	93%
Goat, % farms	88%	73%	60%
Goat, % total LU	12%	11%	30%
Camel, % farms	18%	0%	0%
Camel, % total LU	9%	0%	0%
Cattle, % farms	24%	80%	80%
Cattle, % total LU	2%	27%	24%
Pigs, % farms	0%	0%	0%
Pigs, % total LU	0%	0%	0%

Regarding the animal species conforming of the farms, 94% of the farms had at least two different species. The 88% of the farms had goat, the 18% camels and the 24% cattle, but the second species supposed a low percentage of livestock unit (12%, 9% and 2%, respectively).

The indexes indicating the intensity of the systems are presented in Table 5. The Extensive and Intensive systems presented greater sheep land use per UAA, but this index was reduced when the land use is expressed in total land available (taking into account the common lands and grazing areas). Extensive system presented the highest value of labour use, due to the greater number of livestock unit.

Table 5: Results related to the intensity of the small ruminant farms in Egypt.

Farming System	Extensive	Intensive	Semi-Intensive
Sheep			
Sheep land use/UAA[1]	5.0	5.4	1.3
Sheep land use[2]	1.3	5.4	1.0
Sheep labour use [3]	10.3	3.0	1.4
Sheep/goat			
Sheep/goat land use[1]	5.9	6.6	2.0
Sheep/goat land use[2]	1.5	6.6	1.6
Sheep/Goat labour use[3]	12.0	3.6	2.2

[1] Livestock unit/ Utilised Agricultural Area (ha); [2] Livestock unit/total land available (ha); [3] Livestock unit /total work unit

3.1.4 Reproductive management

Data about the reproductive management of Egypt is presented in Table 6.

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Continuous lambing system is the most spread reproductive system, supposing 53%, 100% and 93 % in Extensive, Intensive and Semi-Intensive, respectively. Consequently, the male effect was used occasionally in Extensive and Semi-Intensive system.

Hormonal treatments were only used in a 7% of farms for large ruminants in the Semi-Intensive system, whereas in the rest of the system they did not used. None of the farms did artificial insemination. In the Intensive system 67% of the farms did pregnancy diagnosis, followed by the Semi-Intensive system with 40% and the Extensive system with 35%. Regarding the lambing season, Extensive and Intensive systems had main lambing period in Autumn, whereas in the Semi-Intensive system in Winter.

Table 6: Results related to reproductive management of Flock obtained from the Egypt's surveys

Farming System	Extensive	Intensive	Semi-Intensive
Lambing system, % farms			
Continuous	53%	100%	93%
1 lambing/ year	6%	0%	0%
1 main+1 second	0%	0%	0%
3 lambings/ 2 years	41%	0%	7%
5 lambings/ 2 years	0%	0%	0%
Male effect, % farms	53%	0%	67%
Hormonal treatment, % farms	0%	0%	0%
Artificial insemination, % farms	0%	0%	0%
Pregnancy diagnosis, % farms	35%	67%	40%
Age at first lambing, months	15	17	15
Lambing season			
Autumn, %	57%	57%	30%
Summer, %	9%	1%	9%
Spring, %	22%	16%	14%
Winter, %	12%	25%	47%

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The Table 7 presented the reproductive indexes estimated. Extensive system presented greater fertility than the rest of the system, however it presented the lowest prolificacy. The productivity, related to lamb sale, was similar among systems, but when it was included the self-consumption, the productivity increased in the Extensive and Semi-Intensive systems. The lamb mortality varied among systems, the Intensive system presented the highest mortality with 37%, followed by Semi-Intensive system with 18% and finally the Extensive system with 10%.

Table 7: Reproductive index of Flock obtained from the Egypt's surveys

Farming System	Extensive	Intensive	Semi-Intensive
Fertility[1]	1.1	0.9	0.9
Prolificacy[2]	1.1	1.5	1.4
Productivity (sold)[3]	0.5	0.4	0.5
Productivity (sold+consumed)[4]	0.6	0.4	0.7
Lamb mortality[5]	10%	37%	18%
Self consumption[6]	4%	6%	13%

[1]number lambings/ewe/yr; [2]number lambs/lambing; [3] number lambs sold/ewe/yr; [4]lambs sold+consumed/ewe/yr; [5] lambs dead/ newborns*100; [6] lambs consumed/ newborns*100

3.1.5 Feeding management

The feeding management of adult herd varied among systems (Table 8). The Extensive system grazed on average 219 días, the 60% of this time on dry rangelands, and the rest on stubbles of barley. The rest of the year ewes from Extensive system were supplemented mainly with concentrate supplements. In the Intensive system there was no grazing, ewes were kept indoor, and clover was cut and carry in winter and maize in summer, the rest of the year ewes received crop residues with some feed concentrates. The Semi-extensive system grazed, on average 315 days, 58% of this time on forage crops, mainly clover), 24% of time on dry rangelands and the rest on stubbles.

Regarding the lambs feeding management (Table 8), grazing is a common practice in all farming systems, although the days on grazing varied among them, with 243, 115 and 79 grazing days in Intensive, Extensive and Semi-Intensive systems. Lambs were

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supplemented mainly with concentrates in Extensive and Intensive systems and with forage n Semi-Intensive. All farms fattened their own lambs post-weaning, except 6% of farms belonging to Extensive system.

Table 8: Results related to feeding management of Flock (adult and lamb) obtained from the Egypt's surveys

Farming System	Extensive	Intensive	Semi-Intensive
Adult herd			
Days on pasture, d	219	0	315
dry rangelands, % days	60%	0%	24%
stubble, % days	40%	0%	17%
forage crops, % days	0%	0%	58%
Suplementation			
Type of supplement, % farms			
Energy+fibre	18%	0%	14%
Energy	82%	100%	71%
Fibre	0%	0%	14%
Lamb feeding			
Suckling period			
Grazing, % farms	100%	100%	100%
days on pasture, d	115	243	79
Type of supplement, % farms			
Energy	88%	71%	31%
Fibre	0%	0%	62%
Both	12%	0%	8%
no supplement	0%	29%	0%
Post-weaning period			
On-farm fattening, % farms	94%	100%	100%
Type of supplement, % farms			
both	35%	33%	0%
energy	53%	67%	60%
fibre	12%	0%	40%

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3.1.6 Lamb sales

The selling criteria of lambs varied among systems, although the weight was more determinant than the age of lambs (Table 9). In the Extensive and Intensive systems, farmers sold more than 80% of lambs in the category of heavy lambs (>26 kg BW) and the rest in the category of light lamb (<26 kg). In the Semi-Intensive system, they sold less lambs in the category of heavy lambs, the 67%, and the rest in the as light lamb.

Table 9: Results related to lamb sale obtained from the Egypt's surveys

Farming System	Extensive	Intensive	Semi-Intensive
Selling criteria, % farms			
Age	13%	33%	40%
Weight	44%	47%	50%
Both	44%	20%	10%
Category, % lambs sold			
Heavy lamb	88%	87%	67%
Light lamb	12%	13%	33%
Suckling lamb	0%	0%	0%
Quality label, % farms	0%	0%	0%

3.2 Spain

In Spain it was conducted a total of 25 surveys, divided into three systems: 7 in Dryland system, 9 in Irrigated system and 9 in Mountain system.

3.2.1 Family and Labour

The family and labour data by farming system is presented in Table 10.

The family size was similar among systems with an average of 3.2 family members. The farmer's age varied among the systems with 56, 46 and 42 years old in Dryland, Irrigated and Mountain systems, respectively.

Most of the farmers did not know if they have generation turnover, thus the future of farm is uncertain. Irrigate system presented the greatest generation turnover, with a continuity of 22%, while the Mountain system had no generation turnover. This reflects the important problem about the continuity in the small ruminant farms observed in Spain.

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Regarding the labour, dryland and irrigated systems presented more people working on the farm than mountain system. Almost half of the total labour in Dryland and Irrigated systems are hired, whereas Mountain system only disposed family labour.

Table 10: Results related to Family and labour aspects obtained from the Spain's Surveys

Farming System	Dryland	Irrigated	Mountain
Family members			
Age > 65 years	0.1	0.2	0.1
Age 65-18 years	2.6	2.0	2.1
Age < 18 years	0.4	0.9	1.0
Farmer's age	56.4	45.9	42.0
Continuity			
yes	14%	22%	0%
no	14%	11%	11%
not known	71%	67%	89%
Labour			
Family labour, WU	1.5	1.7	1.0
Hired labour, WU	1.2	2.0	0.0
Total labour, WU	2.7	3.6	1.0
Family labour,%	64%	54%	100%

3.2.2 Land Use

The land use in Spain is presented in Table 11. The UAA, was composed only by cereal (wheat, barley, corn, triticale) and forage crops (alfalfa, ryegrass, festuca, white clover, vetch, sainfoin), and differed among systems. The Irrigated system had greater UAA than the rest of systems, with a total of 338 ha, which 184 corresponds to cereal crops, and 154 to forage crops. The Dryland system presented 238 ha, most of them cereal crops, and the Mountain system presented an average lower UAA, 78 ha of which 34 were cereal crops, and 43 forage crops. Considering the common lands, the total land available increased considerably. However, the surface data used from common land was not always known by farmers, mainly when concerning mountain areas, as it is the case of

Mountain systems. Thus the surface value showed in the table should be carefully considered. In Dryland and Irrigated systems, the common lands in general were rangelands, scrubland or intermediate zones owned by the village that they belong to. The owned area of UAA was low, between 35% in Irrigated, 40% Mountain and 50% in Dryland. This result indicates, that farmers had to rent considerable surface of lands, besides of the availability of common lands. As expected, the percentage of irrigated area was higher in the Irrigated system, with 0% of irrigation in the Dryland system and only 7% in the Mountain system.

Table 11: Results related to Family and labour aspects obtained from the Spain's Surveys

Farming System	Dryland	Irrigated	Mountain
Utilised Agricultural Area (UAA) (ha)	238.4	338.2	76.9
Permanent crops, ha	0.0	0.0	0.0
Cereal crops,ha	233.4	184.2	33.7
Forage crops, ha	5.0	154.0	43.3
Use of common lands, % farms	100%	89%	89%
Common lands, ha	3282	3100	185
Total land available (ha)	3526.5	3438.2	273.8
Owned, % UAA	50%	35%	40%
Irrigated, % UAA	0%	68%	7%

3.2.3 Flock

The flock size, the replacement rate and the breeds used in Spain are presented in Table 12.

The flock size varied among systems, with 2360 adults in ewes in Irrigated system, 1115 in Dryland system and 554 in Mountain system. The replacement rate was similar between systems, from 12% (Dryland and Mountain systems) to 15% (Irrigated system), and the main breed used was Rasa Aragonesa, a local breed largely spread in this region

Most of the Dryland and Mountains systems farmers belong to one association, according to the breed that they used, with percentages of 86 and 78, respectively, providing data most of the farms (71 and 67 %). In contrast, only the 33% of the farms from Irrigated system were member of a breeder association and only the 22% of those provided data.

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Table 12: Results related to characteristic of Flock obtained from the Spain's surveys

Farming System	Dryland	Irrigated	Mountain
Sheep flock			
adult ewes, n	1115	2360	554
adult rams, n	153	276	84
replacement ewes, n	25	63	16
Replacement rate,%	12%	15%	12%
Sheep breed			
Rasa Aragonesa, %	100%	89%	100%
Other, %	0%	11%	0%
member of breeders' association, % farm	86%	33%	78%
provider of data, % farm	71%	22%	67%
Flock source ewes, % farms			
own	100%	89%	100%
bought	0%	11%	0%
both	0%	0%	0%
Flock source rams, % farms			
own	43%	44%	11%
bought	0%	11%	33%
both	57%	44%	56%
Mixed-species farms	43%	67%	33%
Goat, % farms	29%	56%	22%
Goat, % total LU	1%	1%	0%
Pigs, % farms	14%	33%	0%
Pigs, % total LU	12%	15%	0%
Cattle, % farms	0%	11%	0%
Cattle, % total LU	0%	2%	0%

The replacement of ewes was mostly done from the own flock and the rams were replaced from own flock and bought (Table 12). Regarding the mixed species farms, the greatest percentage corresponded to Irrigated systems with 67%, followed by Dryland system with 43% and Mountain system with 33% of farms. The other species of farm

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were mainly goats (from 22 in Mountain to 56% in Irrigated), and pigs (from 14 in Dryland to 33% in Irrigated). Cattle only was recorded in a 11% of farms from the Irrigated system.

The land use and labour use are presented in Table 13. Irrigated system presented the greatest land use, with 2.5 LU/UAA, and similar land use in Dryland and Mountain systems. However, when the land use is related to total land available, decreased the index in all systems but in a lesser extend in Mountain system. In terms of labour use, Dryland system presented the lowest index, while Irrigated and Mountain systems presented higher index with 105 and 98 LU/WU, respectively.

Table 13: Results related to the intensity of the small ruminant farms in Spain

Farming System	Dryland	Irrigated	Mountain
Sheep land use[1]	1.9	2.5	1.6
Sheep land use[2]	0.2	0.2	1.3
Sheep labour use [3]	67.0	105.6	98.8
Sheep/goat land use[1]	1.9	2.6	1.6
Sheep/goat land use[2]	0.2	0.2	1.3
Sheep/Goat labour use[3]	67.7	107.1	99.2

[1] Livestock unit/ Utilized Agricultural Area (ha); [2] Livestock unit/total land available (ha); [3] Livestock unit /total work unit

3.2.4 Reproductive management

Reproductive data of Spain by farming system is presented in Table 14. The most common lambing systems used was the 3 lambing in 2 years, and a low percentage of farms used also 5 lambing in 2 years. This last lambing system is associated with intensives systems, and thus is more spread in Irrigated system (33%), whereas the rest of systems only used this system less than 15% of farms.

The male effect is widely used in Spain, with more than 50% of farm using it, being the Dryland system the system that this practice was less extended (57%), whereas the rest of systems it was used almost in 80% of farms. Hormonal treatments were a practice often used, being the implantation of melatonin one month before the mating during the anestrus period (starting the spring) the most common used. Artificial insemination was rarely used, less than 30%, and only farms from Dryland (29%) and from Irrigated (14%) use this practice. Pregnancy diagnosis was done in 44% of farms in Mountain system

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and in 14% in Irrigated system. The age at first lambing was 15 months in Irrigated system and 16 months in Dryland and Mountain systems. The lambing season were distributed thought the year depending on the farming system.

Table 14: Results related to reproductive management of Flock obtained from the Spain's surveys

Farming System	Dryland	Irrigated	Mountain
Lambing system, % farms			
Continuous	0%	0%	0%
1 lambing/ year	0%	0%	0%
1 main+1 second	0%	0%	11%
3 lambings/2 years	86%	67%	78%
5 lambings/2 years	14%	33%	11%
Male effect, % farms	57%	78%	78%
Hormonal treatment, % farms	86%	44%	78%
Artificial insemination, % farms	29%	14%	0%
Pregnancy diagnosis, % farms	0%	14%	44%
Age at first lambing, months	16	15	16
Lambing pattern			
Autumn, %	5%	25%	18%
Summer, %	28%	18%	23%
Spring, %	36%	27%	30%
Winter, %	31%	31%	29%

Table 15 presented some reproductive indexes. All systems presented the same productivity 1.4 lambs sold per ewe per year, with small variation in fertility, prolificacy and lamb mortality.

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Table 15: Reproductive index of flocks obtained from the Spain's surveys

Farming System	Dryland	Irrigated	Mountain
Fertility[1]	1.1	1.3	1.2
Prolificacy[2]	1.7	1.5	1.4
Productivity[3]	1.4	1.4	1.4
Lamb mortality[4], % newborns	6%	10%	8%

[1]number lambings/ewe/yr; [2]number lambs/lambing; [3] number lambs sold/ewe/yr; [4]lambs dead/ newborns*100.

3.2.5 Feeding management

The feeding management of adult herd is presented in Table 16. In all systems, flocks grazed at least 7 months, with longer period in Dryland system, almost 9 months, and 8 months in Irrigated system. During the grazing period the flock did not receive supplementation. When ewes presented greater nutritional requirements (lambing and during lactation) were supplemented usually indoor with concentrate or cereal plus forage (straw or hay). However, in Irrigated system some farms supplement only with high quality forage, mainly silage. In Mountain system, during winter ewes were fed indoor, because of the lack of pastures.

In Spain, lambs did not spend any time grazing, regardless of the Livestock system. Lambs were supplemented with concentrate plus straw. The 86 % of the farms fattened their lambs in the own farm in the Dryland system, whereas in Irrigated and Mountains system were 67% of the farms. However, it must be highlighted that most of farm sold the lambs to a Cooperative feedlot to finish the fattening.

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Table 16: Results related to feeding management of Flock (adult and lamb) obtained from the Spain's surveys

Farming System	Dryland	Irrigated	Mountain
Adult herd			
Days on grazing, d	269	252	213
dry rangelands, % days	49%	30%	41%
stubble, % days	41%	48%	20%
forage crops, % days	10%	22%	39%
Type of supplement, % farms			
Energy+fibre	71%	44%	67%
Energy	29%	33%	33%
Fibre	0%	22%	0%
Lamb feeding			
Suckling period			
Grazing, % farms	0%	0%	0%
Days on pasture	0	0	0
Type of supplement, % farms			
energy	0%	0%	0%
fibre	0%	0%	0%
Energy+fibre	100%	100%	100%
no supplement	0%	0%	0%
Post-weaning period			
On-farm fattening, % farms	86%	67%	67%
Type of supplement, % farms			
energy	0%	0%	0%
fibre	0%	0%	0%
Energy+fibre	100%	100%	100%

3.2.6 Lambs sales

The criteria for selling lambs was exclusively by weight in all three systems (Table 17). In Dryland and Irrigated systems all lambs sold were in the light lamb category (<26kg), but

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in the Mountain only the 67% and the rest was sold as the category of suckling lamb. There is a quality label for light lamb named "Ternasco de Aragón", Dryland systems sold under this quality label, whereas in the Irrigated systems only 33% of the farms sold under it and in Mountain systems the 67% in agreement with the farms that sold light lamb, as there is not any quality label for suckling lamb yet.

Table 17: Results related to lamb sale obtained from the Spain' surveys

Farming System	Dryland	Irrigated	Mountain
Selling criteria, % farms			
weight	100%	100%	100%
age	0%	0%	0%
both	0%	0%	0%
Category, % lambs sold			
Heavy lamb	0%	0%	0%
Light lamb	100%	100%	67%
Suckling lamb	0%	0%	33%
Quality label, % farms	100%	33%	67%

3.3 Tunisia

In Tunisia it was conducted a total of 96 surveys, divided into three systems: 63 in agro-pastoral system, 24 in agro-sylvo-pastoral system and 9 in fatteners system. The agro-pastoral system has been divided into two, regarding the irrigation systems, 45 surveys were conducted in agro-pastoral rainfed system and 18 in agro-pastoral irrigated system. The fattener system was not taken into account due the lack of data in most of the conducted surveys.

3.3.1 Family and Labour

The family and labour data by farming system is presented in Table 18.

Agro-pastoral irrigated system presented on average 5.9 family members, followed by Agro-pastoral system with 4.8 members and Agro-sylvo-pastoral system with 3.3. These differences among farming systems are in line with the percentage of continuity of the farms, greater family members resulted in greater continuity. The 61% of the farms of

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Agro-sylvo-pastoral system does not have continuity, which indicates a future problem for the sector and their continuity. Regarding the labour, the three systems presented similar composition of the labour with a total work unit around 2 per farm, being more than 90% of family.

Table 18: Results related to Family and labour aspects obtained in the Tunisian study area.

Farming System	Agro-pastoral rainfed	Agro-pastoral irrigated	Agro-sylvo-pastoral
Family members			
Age > 65 years	0.3	0.4	0.7
Age 65-18 years	3.1	3.7	2.1
Age < 18 years	1.4	1.8	0.5
Farmer's age	46.3	44.6	48.1
Continuity			
yes	65%	89%	22%
no	26%	6%	61%
not known	9%	6%	17%
Labour			
Family labour, WU	2.0	1.9	2.0
Hired labour, WU	0.2	0.2	0.1
Total labour, WU	2.2	2.1	2.1
Family labour,%	95%	92%	96%

WU= Work unit

3.3.2 Land Use

The land use is presented in Table 19. Agro-pastoral rainfed system presented the greatest UAA with 118 ha, which were dedicated to cereal crops (73 ha), permanent crops (17 ha) and forage crops (31 ha). The Agro-pastoral irrigated system presented the lowest UAA with an average near 23 ha, 13 of them were cereal crops, 8 permanent crops and 02 forage crops. The Agro-sylvo-pastoral system presented an average of 59 ha of UAA, most of them cereal crops, being the rest of crops negligible. The UAA was mainly owned

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in all systems, and only the Agro-pastoral irrigated system presented irrigated area, being close the half of the UAA. When the common land was considered total land available increases especially in Agro-sylvo-pastoral and Agro-pastoral.

Table 19: Results related to Land Use aspects obtained in Tunisia

Farming System	Agro-pastoral rainfed	Agro-pastoral irrigated	Agro-sylvo-pastoral
Utilised Agricultural Area (UAA) (ha)	118	22.6	59.1
Permanent crops, ha	16.5	8.1	2.3
Cereal crops,ha	72.7	12.7	56.8
Forage crops, ha	30.9	1.8	0.1
Owned, % UAA	80%	95%	80%
Irrigated, % UAA	0%	48%	0%
Use of common lands, % farms	65%	69%	100%
Common lands, ha	73	12	166
Total land available (ha)	195.5	34.9	228.9

3.3.3 Flock

The flock size, the replacement rate and the breeds used in Tunisia are presented in Table 20. The Agro-pastoral rainfed system had the highest number of ewes (121 ewes) followed by the Agro-sylvo-pastoral system (112 ewes) with a 14% of replacement rate. The Agro-pastoral irrigated system presented smaller flocks, half of the ewes (64), with a 17% of replacement rate. The main breed used was the "Queue Fine de l'Ouest" in both Agro-pastoral rainfed and Agro-pastoral irrigated systems, and the "Barbarine" breed was the most common breed used the in Agro-sylvo pastoral system.

All the surveyed farmers are not members of a breeders' association, probably because this type of association was not well established and farmers are not yet conscious of the importance of structuring their activity. In the same line, the percentage of the farmers that provide data was low, (between 11%-25%).

The flock source of ewes was own or own+bought in all systems, a low percentage of farms from both agro-pastoral systems (6-7%) bought all their replacements ewes. The

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source of males was similar to that of ewes, although in this case the percentage of farms buying exclusively the rams is higher, with values between 22 and 29%.

More than 70% of the farms were composed by mixed flocks using several species, mainly goats, followed by cattle and camels (Table 20).

Table 20: Results related to characteristic of Flock obtained from the Tunisian's surveys

Farming System	Agro-pastoral Rainfed	Agro-pastoral irrigated	Agro-sylvo-pastoral
Sheep flock			
adult ewes, n	121	64	112
adult rams, n	20	10	13
replacement ewes, n	5	6	5
Replacement rate,%	14%	17%	14%
Sheep breed			
Barbarine, %	20%	0%	58%
Black of Thibar, %	9%	0%	13%
Queue Fine de l'Ouest (Western Thin tail), %	62%	89%	25%
Other, %	9%	11%	4%
member of a breeders' association, % farm	NA	NA	NA
provider of data, % farm	25%	11%	18%
Flock source ewes, % farms			
own	53%	39%	43%
bought	7%	6%	0%
both	40%	56%	57%
Flock source rams, % farms			
own	44%	67%	29%
bought	28%	22%	29%
both	28%	11%	43%
Mixed-species farms	78%	72%	71%
Goat, % farms	67%	67%	50%

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Goat, % total LU	12%	12%	8%
Camel, % farms	0%	6%	0%
Camel, % total LU	0%	1%	0%
Cattle, % farms	24%	22%	42%
Cattle, % total LU	7%	10%	11%
Pigs, % farms	0%	0%	0%
Pigs, % total LU	0%	0%	0%

The land use and labour use are presented in Table 21. Agro-sylvo-pastoral system had the highest land use with 1.5 LU per ha UAA, whereas both Agro-pastoral rainfed and Agro-pastoral irrigated had 0.6 and 0.8, respectively. However, when it was expressed per ha of total land available (considering the common lands and grazing areas), the Agro-pastoral irrigated had 1.3 whereas Agro-pastoral Rainfed and Agro-sylvo-pastoral had 0.4 and 0.6, respectively. In terms of labour use, the agro-pastoral presented 9.3 LU per WU, Agro-sylvo-pastoral system 8.3 LU/WU and Agro-pastoral irrigated 5.2 LU/WU.

Table 21: Results related to the intensity of the small ruminant farms in Tunisia

Farming System	Agro-pastoral rainfed	Agro-pastoral irrigated	Agro-sylvo-pastoral
Sheep land use/UAA[1]	0.6	0.8	1.5
Sheep land use[2]	0.4	1.3	0.6
Sheep labour use [3]	9.3	5.2	8.3
Sheep/goat land use[1]	0.7	1.0	1.6
Sheep/goat land use[2]	0.5	1.5	0.7
Sheep/Goat labour use[3]	10.2	6.1	8.7

[1] Livestock unit/ Utilized Agricultural Area (ha); [2] Livestock unit/total land available (ha); [3] Livestock unit /total work unit

3.3.4 Reproductive management

Reproductive data of Tunisia by farming system is presented in Table 22. The main lambing systems used were continuous and 1 lambing season. Some farmers said that

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they used male effect, but it was not consistent with the percentage of farms that use 1 lambing season. The percentage of farms that use hormonal treatment was low, only 9 and 8% in Agro-pastoral and Agro-sylvo pastoral systems. The age at first lambing was similar among farming system, between15 and 16 months. The main lambing occurred in Autumn in the three systems.

Table 22: Results related to reproductive management of Flock obtained from the Tunisian's surveys

Farming System	Agro-pastoral rainfed	Agro-pastoral irrigated	Agro-sylvo-pastoral
Lambing system, % farms			
Continuous	53%	78%	43%
1 lambing/ year	23%	6%	39%
1 main+1second	21%	11%	13%
3 lambings/2 years	2%	6%	4%
5 lambings/2 years	0%	0%	0%
Male effect, % farms	36%	17%	42%
Hormonal treatment, % farms	9%	0%	8%
Artificial insemination, % farms	9%	0%	0%
Pregnancy diagnosis, % farms	9%	0%	25%
Age at first lambing, months	15	16	16
Lambing season			
Spring, %	2%	7%	0%
Summer, %	28%	19%	21%
Autumn, %	50%	54%	63%
Winter, %	20%	21%	16%

The reproductive indexes studied are similar among farming systems, although Agro-sylvo-pastoral system presented some worse results, as prolificacy and productivity (Table 23),

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Table 23: Reproductive index of flocks obtained from the Tunisian surveys

Farming System	Agro-pastoral	Agro-pastoral irrigated	Agro-sylvo-pastoral
Fertility[1]	0.9	0.9	0.8
Prolificacy[2]	1.2	1.2	1.1
Productivity[3](sold)	0.9	0.8	0.7
Productivity[4] (sold+consumed)	0.9	0.9	0.8
Lamb mortality[5]	8%	10%	7%
Self consumption[6]	5%	8%	5%

[1]number lambings/ewe/yr; [2]number lambs/lambing; [3] number lambs sold/ewe/yr; [4]lambs sold+consumed/ewe/yr; [5] lambs dead/ newborns*100; [6] lambs consumed/ newborns*100

3.3.5 Feeding management

The time adult herd spends on pasture varies according to the system (Table 24). Agro-sylvo-pastoral systems spends more time than the rest, on average 330 days compared to 279 days for the Agro-pastoral irrigated system and 261 days for Agro-pastoral system. The type of supplement also varies according to the system, they mainly use energy supplement or energy+fibre supplements.

The feeding management of the lambs is presented in Table 24. Lambs, from most of the farms, grazed between 76% and 91% according to the system. The time of the grazing varied according to the system. The type of supplement depended on the period if the lambs are lactating or not. More than 80% of the farms in the three systems fattened their own lambs.

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Table 24: Results related to feeding management of Flock (adult and lamb) obtained from the Tunisian surveys

Farming System	Agro-pastoral	Agro-pastoral irrigated	Agro-sylvo-pastoral
Adult herd			
Days on pasture, d	261	279	330
Type of supplement, % farms			
Energy+fibre	42%	67%	4%
Energy	53%	28%	96%
Fibre	5%	6%	0%
Lamb feeding			
Suckling period			
Grazing, % farms	84%	76%	91%
days on pasture, d	269	365	263
Type of supplement, % farms			
energy	16%	28%	17%
fibre	18%	6%	21%
both	48%	39%	54%
no supplement	18%	28%	8%
Post-weaning period			
On-farm fattening, % farms	87%	83%	88%
Type of supplement, % farms			
energy	19%	6%	4%
fibre	19%	35%	26%
both	62%	59%	70%

3.3.6 Lambs sales

The selling criteria of lambs varied among systems (Table 25). Agro-pastoral sold their lambs by weight and by both, age and weight, whereas the Agro-pastoral irrigated and Agro-sylvo-pastoral systems sold their lambs mainly by weight, and only 18-20% by both,

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age and weight. The category of lambs sold varies according to the system, with 62%, 20% and 96% as heavy lambs (>26 kg) for Agro-pastoral, Agro-pastoral irrigated and Agro-sylvo-pastoral system, respectively. The rest of lambs were sold as light lambs.

Table 25: Results related to lamb sale obtained from the Tunisian surveys

Farming System	Agro-pastoral rainfed	Agro-pastoral irrigated	Agro-sylvo-pastoral
Selling criteria, % farms			
weight	44%	80%	82%
age	0%	0%	0%
both	56%	20%	18%
Category, % lambs sold			
Heavy lamb	62%	29%	96%
Light lamb	38%	71%	4%
Suckling lamb	0%	0%	0%
Quality label, % farms	0%	0%	0%

3.4 France

France developed a total of 32 surveys, divided into two systems: 17 plainHills and 15 in PreAlps.

3.4.1 Family and Labour

The family and labour data by farming system in France is presented in Table 26. PlainHills system and PreAlps system presented similar family size on average of 3.2 members and labour composition with a total WU of 2.4 being the 30% of the family. The only difference observed was regarding the continuity, in PreAlps system the 33% of the farms knew that they won't be continuity whereas in the PlainHills most of the farms did not know yet (57% of the farms).

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Table 26: Results related to Family and labour aspects obtained in France

Farming System	Plain-Hills	Pre-Alps
Family members		
Age > 65 years	0.3	0.3
Age 65-18 years	1.9	1.8
Age < 18 years	1.3	1.1
Farmer's age	42.9	44.2
Continuity		
yes	36%	33%
no	7%	33%
not known	57%	33%
Labour		
Family labour, WU	0.9	0.8
Hired labour, WU	1.6	1.5
Total labour, WU	2.4	2.3
Family labour,%	29%	30%

3.4.2 Land Use

The land use in France is presented in Table 27. The UAA was calculated considering permanent, cereal and forage crops, rangelands, and permanent pasture. The PreAlps system presented higher UAA than PalinHills, 605 *vs*. 184, respectively. However, when the common lands were also considered, the total land available increased being this increase major in PlainHills systems, and then, the difference among system was lower. The percentage of land owned (±10%) and irrigated (±8%) was low in both systems.

Table 27: Results related to Land Use aspects obtained in France

Farming System	PlainHills	PreAlps
Utilised Agricultural Area (UAA) (ha)	184.0	605.5
Permanent crops, ha	2.3	21.9
Cereal crops, ha	11.0	5.9
Rangelands, ha	32.9	121.7
Permanent pasture, ha	117.4	401.9
Forage crops, ha	23.2	54.0
Owned, % UAA	12%	8%
Irrigated, % UAA	9%	6%
Use of common lands, % farms	76%	73%
Common lands, ha	476	227
Total land available (ha)	660.5	832.2

3.4.3 Flock

The flock size, the replacement rate and the breeds used in France are presented in Table 28. The PreAlps system presented higher numbers of ewes, 890 ewes, and 20% of replacement rate, whereas PlainHills system had 522 ewes and 15% of replacement rate. The main breed used was Merinos in both systems, but an important number of farmers used different sheep breed. Only around 35% of the farms were members of a breed association, what can be due to the different breeds used and presented as othersS.

The source of females was mainly own and bought in PlainHills system and own in PreAlps system, whereas flock source of males was mainly bought in both systems. The 29% of the farms of PlainHills and the 40% in the PreAlps were composed by several species, mainly goats and in PreAlps system besides of goat also had some pigs, however they hardly represent any LU (0.02%).

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Table 28: Results related to characteristic of Flock obtained in France

Farming System	PlainHills	PreAlps
Sheep flock		
adult ewes, n	522	890
adult rams, n	96	193
replacement ewes, n	16	19
Replacement rate,%	15%	20%
Sheep breed		
BMC %	6%	7%
Merinos, %	53%	40%
Pré Alps, %	18%	0%
Lacaune, %	0%	13%
Other, %	24%	40%
member of a breeders' association, % farm	35%	33%
provider of data, % farm	NA	NA
Flock source ewes, % farms		
own	35%	87%
bought	29%	0%
both	35%	13%
Flock source rams, % farms		
own	0%	36%
bought	94%	43%
both	6%	21%
Mixed-species farms	29%	40%
Goat, % farms	6%	7%
Goat, % total LU	0%	1%
Camel, % farms	0%	0%
Camel, % total LU	0%	0%
Cattle, % farms	0%	0%
Cattle, % total LU	0%	0%
Pigs, % farms	0%	7%
Pigs, % total LU	0%	0%

The land and labour use are presented in Table 29. The land use was 0.8 and 0.3 ewe /ha UAA in PlainHills and PreAlps, respectively. However, when it was presented in relation to the total land available (also consider the common lands), it was 0.2 ewes/ha

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of total land available in both systems. PreAlps system presented greater value of Labour use than PlainHills.

Table 29: Results related to the intensity of the small ruminant farms in France

Farming System	PlainHills	PreAlps
Sheep land use[1]	0.8	0.3
Sheep land use[2]	0.2	0.2
Sheep labour use[3]	43.4	60.2
Sheep/goat land use[1]	0.8	0.3
Sheep/goat land use[2]	0.2	0.2
Sheep/Goat labour use[3]	43.4	60.3

[1] Livestock unit/ Utilized Agricultural Area (ha); [2] Livestock unit/total land available (ha); [3] Livestock unit /total work unit

3.4.4 Reproductive management

Reproductive data of France by farming system is presented in Table 30. All farms surveyed in PreAlps system presented 1 lambing season, and most in the PlainHills systems too (88%) with the rest of the farms using the 3 lambing in 2 years. Only 7% of the farms in PreAlps used artificial insemination. The age at first lambing were similar between 19 and 20 months. The lambings were mainly distributed in Autumn, Winter and Summer in both systems

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Table 30: Results related to reproductive management of Flock obtained from the Tunisian's surveys

Farming System	PlainHills	PreAlps
Lambing system, % farms		
Continuous	0.0	0.0
1 lambing/year	88%	100%
1 main+1second	0%	0%
3 lambings/2 years	13%	0%
5 lambings/2 years	0%	0%
Male effect, % farms	NA	NA
Hormonal treatment, % farms	NA	NA
Artificial insemination, % farms	0%	7%
Pregnancy diagnosis, % farms	NA	NA
Age at first lambing, months	19	20
Lambing season		
Autumn, %	29%	34%
Summer, %	26%	36%
Spring, %	7%	0%
Winter, %	38%	30%

The reproductive indexes were similar between farming systems (Table 31), but PlainHills system presented higher productivity (0.2 lambs sold/ewe/year) than PreAlps system.

Table 31: Reproductive index of flocks obtained from the surveys carried out in France

Farming System	PlainHills	PreAlps
Fertility[1]	1.0	0.9
Prolificacy[2]	1.3	1.2
Productivity[3]	0.9	0.7
Lamb mortality[4]	12%	11%

[1]number lambings/ewe/yr; [2]number lambs/lambing; [3] number lambs sold/ewe/yr; [4]lambs dead/ newborns*100.

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3.4.5 Feeding management

The feeding management of adult herd is presented in Table 32. Sheep from the PreAlps systems spent more time grazing (303 days) than the sheep from PlainHills (232 days). Sheep grazed mainly in dry rangelands, especially in the PlainHills system. The type of supplement varied between systems, In PlainHills 76% of farms used combined supplement (Energy+fibre), and 24% of farms used only fibre supplement. In PreAlps system 46% used energy+fibre, 23% only energy, and 31% only fibre.

In a small percentage of farms lambs grazed on pasture, 18% and 27% of the farms with an average of 64 and 104 days on pasture, in PalinHills and PreAlps systems, respectively. Most of the farms fattened their lambs in the own farm (Table 32).

Table 32. Results related to feeding management of Flock (adult and lamb) obtained from the France surveys

Farming System	PlainHills	PreAlps
Adult flock		
Days on pasture, d	232	303
dry rangelands, % days	92%	79%
stubble, % days	1%	4%
forage crops, % days	7%	17%
Type of supplement, % farms		
Energy	0%	23%
Fibre	24%	31%
Energy+fibre	76%	46%
Lamb feeding		
Grazing, % farms	18%	27%
days on pasture, d	64	104
Type of supplement during lactation, % farms		
energy	18%	27%
fibre	12%	7%
Energy+fibre	71%	40%
no supplement	0%	27%
On-farm fattening post weaning, % farms	94%	93%

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3.4.6 Lambs sales

The criteria for selling lambs was the same in both systems, they were sold by weight (Table 33) and the category of lambs sold also was the same in both systemas, heavy lambs (>26kg). The 53% of the farms in PlainHills sold their lambs under quality label, whereas in PreAlps was only 33% of the farms.

Table 33: Results related to lamb sale obtained in France

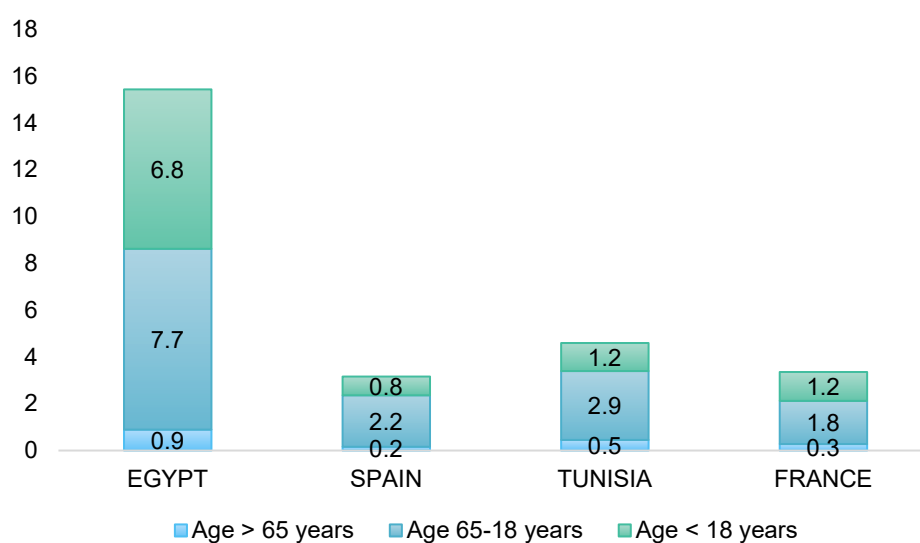| Farming System	PlainHills	PreAlps
Selling criteria, % farms		
weight	100%	100%
age	0%	0%
Weight+age	0%	0%
Category, % lambs sold		
Heavy lamb	100%	100%
Light lamb	0%	0%
Suckling lamb	0%	0%
Quality label, % farms	53%	33%

3.5 Across COUNTRIES

3.5.1 Family and Labour

The family and labour data by country is presented in Table 34. Egypt presented on average 15.4 family members per farm, whereas Spain and France presented 3.2 and Tunisia 4.5, being the range 65-18 years the biggest in all countries, but in Egypt the range lower than 18 years also was important (Table 34).

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Table 34: Results related to Family and labour aspects obtained in Tunisia

COUNTRY	EGYPT	SPAIN	TUNISIA	FRANCE
Family members	15.4	3.2	4.5	3.2
Age > 65 years	0.9	0.2	0.5	0.3
Age 65-18 years	7.7	2.2	2.9	1.8
Age < 18 years	6.8	0.8	1.2	1.2
Farmer's age	46.1	47.4	46.4	43.5
Continuity				
yes	87%	12%	58%	34%
no	13%	12%	31%	21%
not known	0%	76%	11%	45%
Labour				
Family labour, WU	2.0	1.4	2.0	0.8
Hired labour, WU	0.9	1.0	0.2	1.5
Total labour, WU	3.0	2.4	2.2	2.3
Family labour,%	81%	74%	95%	30%

Figure 4 shows the distribution of the family according to the age. Egypt is the country with biggest family size, while Spain and France have similar size and distribution, and Tunisia has values closer to European countries.
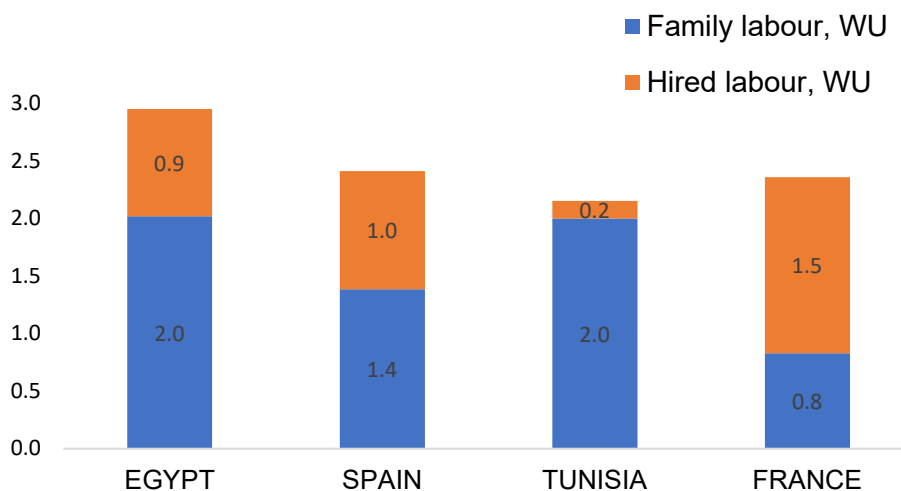

Figure 4: Distribution by age of the family members

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Regarding the continuity, Egypt and Tunisia presented the greatest percentage of farms with continuity, whereas in Spain and France most of the farmers did not know the continuity of their farms (Figure 5).
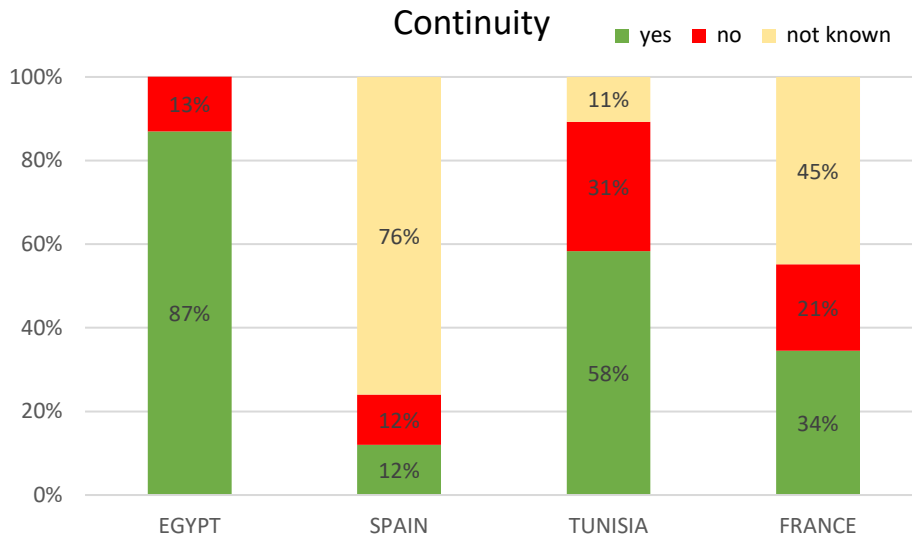
Figure 5: Continuity of farms (yes, no, or not known) in each country studied

The family labour was more important in Egypt and Tunisia, intermedium in Spain, and less important in France, with percentages of 81, 95, 74 and 30% to the total labour, respectively (Figure 6). In Spain and France, the proportion of hired labour was greater than the rest of countries, especially in France where was higher than the family.

Figure 6: Proportion of family and hired labour in each country studied

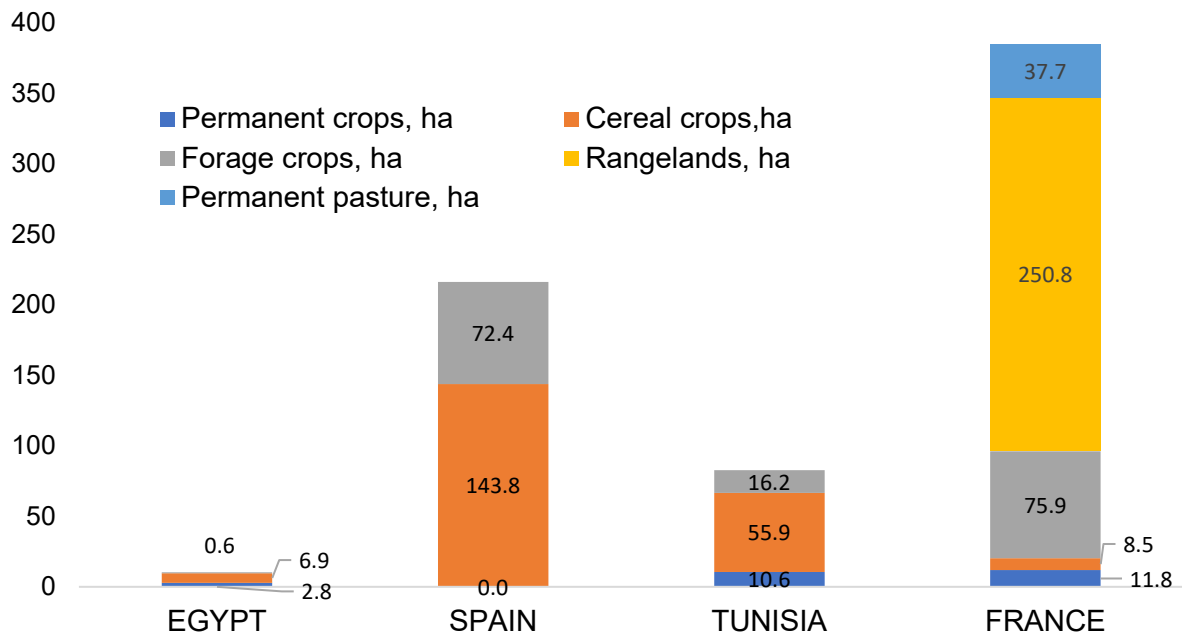Adapt-Herd WP3.1. Characteristics of production systems using sheep and goat local breeds. Report

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3.5.2 Land Use

The land use presented large differences between countries, mainly in surface and type of crops (Table 35). The surface of UAA was small in Egypt and Tunisia, with 10 and 82 ha, varied greatly with the location and production system, and substantially large in Spain and France (Figure 7). However, the conception of crops is different between countries. In Egypt and Tunisia, some permanent pastures were considered as common lands. Besides, farmers did not know the exact surface, as common lands are used by different farmers and even different livestock, therefore these data should be considered with caution (Figure 8). The cereal crop was the most used in Egypt, Spain and Tunisia, while in France it was rangelands, forage crops and permanent pasture. Farmers from Egypt and Tunisia owned more than 50% of UAA, whereas France only 10% and Spain 41%. Egypt presented the greatest percentage of land irrigated. Most of the farms in all countries used common lands, presenting Spain the greatest percentage (92%) and the lowest Egypt (62%) due that the Intensive system that does not use common lands. Spain and France were the countries with more availability and use of common lands, highlighting that in Spain the common lands are an important basis of sheep production (Figure 9).

Table 35 Results related to Land Use aspects in all countries studied

COUNTRY	EGYPT	SPAIN	TUNISIA	FRANCE
Utilised Agricultural Area, ha	10.3	216.2	82.0	381.6
Permanent crops, ha	2.8	0.0	10.6	11.8
Cereal crops,ha	6.9	143.8	55.9	8.5
Forage crops, ha	0.6	72.4	16.2	75.9
Rangelands, ha				250.8
Permanent pasture, ha				37.7
Owned, % UAA	62%	41%	83%	10%
Irrigated, % UAA	61%	27%	11%	8%
Use of common lands, % farms	62%	92%	76%	75%
Common lands, ha	33	2544	85	359
Total land available, ha	47.5	2799.9	171.2	741.0

UAA: Utilised Agricultural Area

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Figure 7: Utilized Agricultural area per country (UAA), ha.
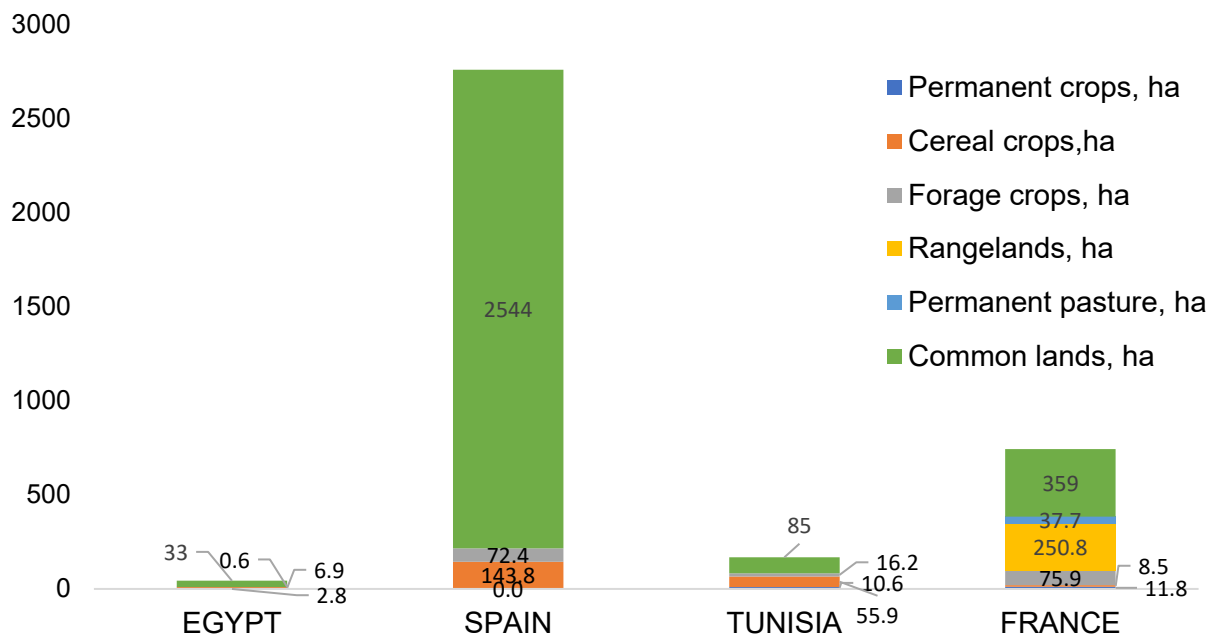
Figure 8: Total land available per country.

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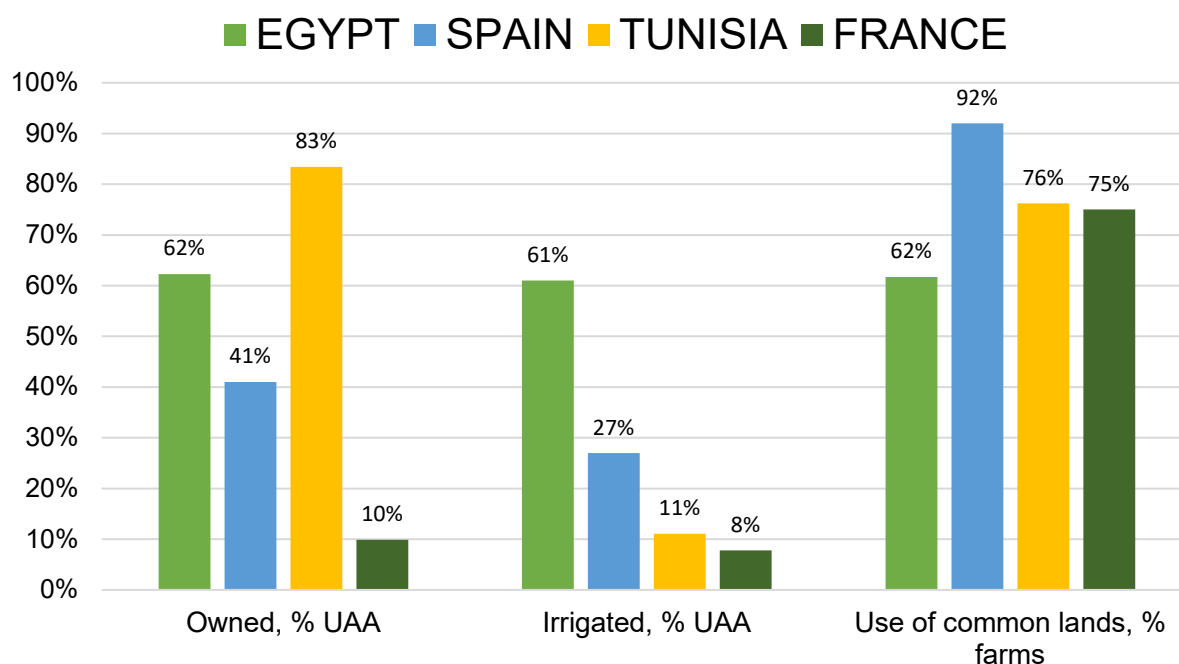
Figure 9: Percentage of surface owned, irrigate and the use of common lands in each country studied.

3.5.3 Flock

The data of the flock by country is presented in Table 36. The flock size differed among production systems and countries, Spain presented the largest number of ewes, ten times more than Tunisia and Egypt and almost twice than France (Figure 10). The replacement rate ranged from 13% to 23% (Figure 11).

Table 36: Results related to characteristic of Flock obtained in all countries

COUNTRY	EGYPT	SPAIN	TUNISIA	FRANCE
Sheep flock				
adult ewes, n	88	1361	107	695
adult rams, n	15	172	16	141
replacement ewes, n	5	35	5	17
Replacement rate,%	23%	13%	14%	17%
Sheep breed				
Baladi, %	34%	0%	0%	0%

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Barbarine, %	0%	0%	26%	0%
Barki, %	33%	0%	0%	0%
Wahati, %	33%	0%	0%	0%
Black of Thibar, %	0%	0%	8%	0%
BMC, %	0%	0%	0%	6%
Merinos, %	0%	0%	0%	47%
Pré Alps	0%	0%	0%	9%
Rasa aragonesa, %	0%	96%	0%	0%
Queue fine de l'Ouest (Western Thin tail) %	0%	0%	57%	0%
Lacaune, %	0%	0%	0%	6%
Other, %	9%	4%	8%	31%
member of a breeders' association, % farm	13%	64%	4%	34%
provider of data, % farm	0%	52%	20%	NA
Flock source ewes, % farms				
own	70%	96%	48%	59%
bought	0%	4%	5%	16%
both	30%	0%	48%	25%
Flock source rams, % farms				
own	50%	32%	47%	17%
bought	7%	16%	27%	70%
both	43%	52%	27%	13%
Mixed-species farms	96%	48%	75%	34%
Goat, % farms	74%	36%	62%	6%
Goat, % total LU	18%	1%	11%	0%
Camel, % farms	6%	0%	1%	0%
Camel, % total LU	3%	0%	0%	0%
Cattle, % farms	60%	4%	29%	0%
Cattle, % total LU	17%	1%	9%	0%
Pigs, % farms	0%	16%	0%	3%
Pigs, % total LU	0%	9%	0%	0%

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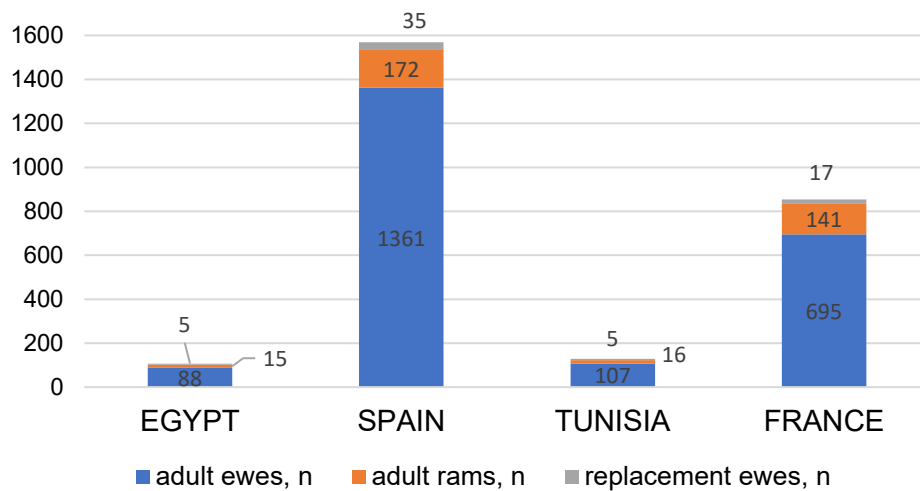
Figure 10: Flock size by country.
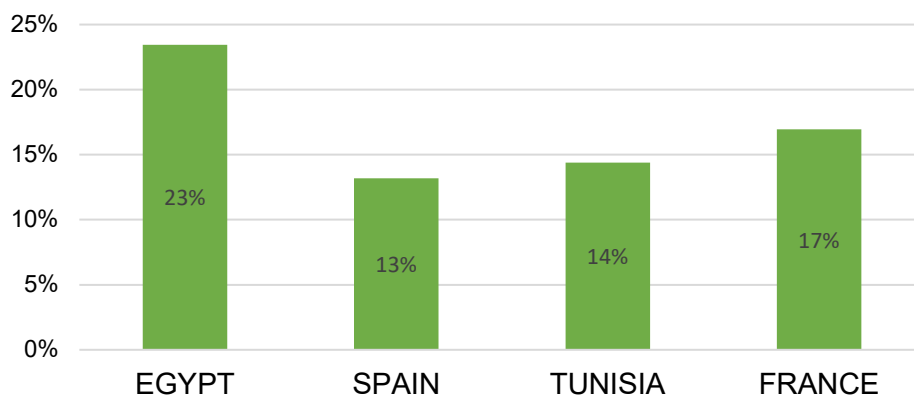
**Figure 11**. Replacement rate in Egypt, Spain, Tunisia and France.

The main breed in Egypt is Baladi, in Spain Rasa Aragonesa, in Tunisia "Queue fine de l'Ouest" (Western Thin Tail) and, in France Merino. It can be observed that France presented the greatest numbers of breeds (Figure 12).

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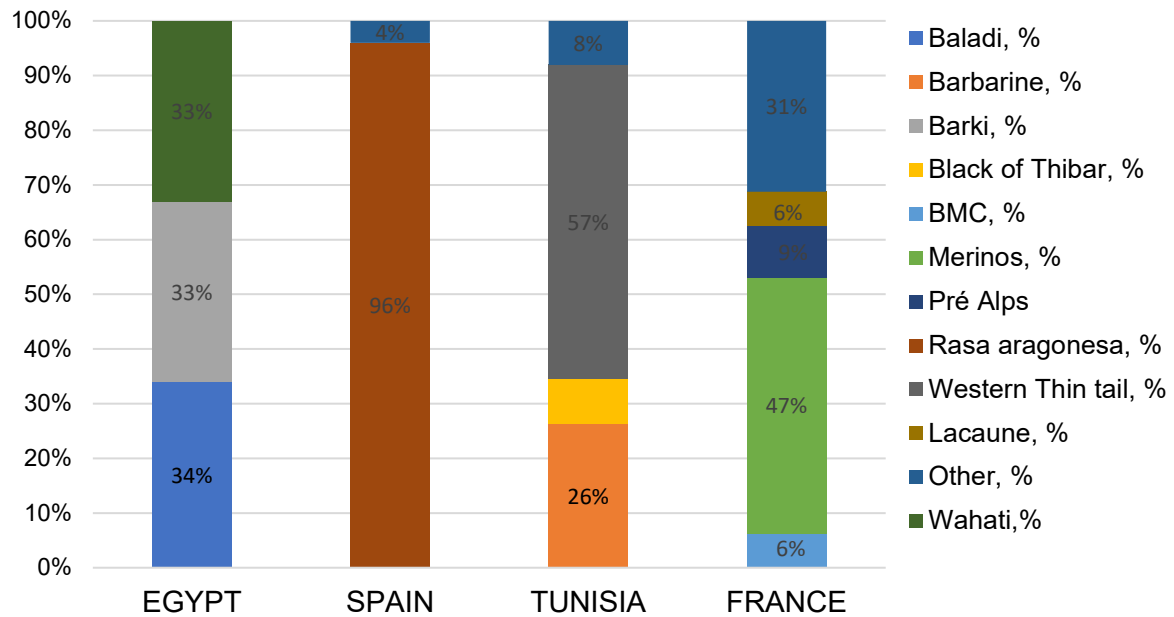
Sheep Breeds

Figure 12: Main sheep breeds used in Egypt, Spain, Tunisia and France.

Egypt was the country with the highest percentage of mixed-specie farms, the 96% of farms had other species than sheep, mainly goats and cattles , followed by Tunisia with the 75%, Spain with 48% and finally France with 34% (Table 36). Egypt and Tunisia had high percentage of mixed-species, mainly goat and cattle, and Spain and France had mainly goats and pigs (Figure 13). The percentage of different species in relation to the total of Livestock unit, in Egypt were 18% of goats and the 17% of cattle, In Tunisia 11 and 9% by goats and cattle, respectively. In Spain, 36% of the farms have goats, but only represent 1% of the total LU and pigs presented the 9% of the total LU. In France these data should be interpreted with caution, because several farmers, although they confirm that had other species, they did not report the number of them.
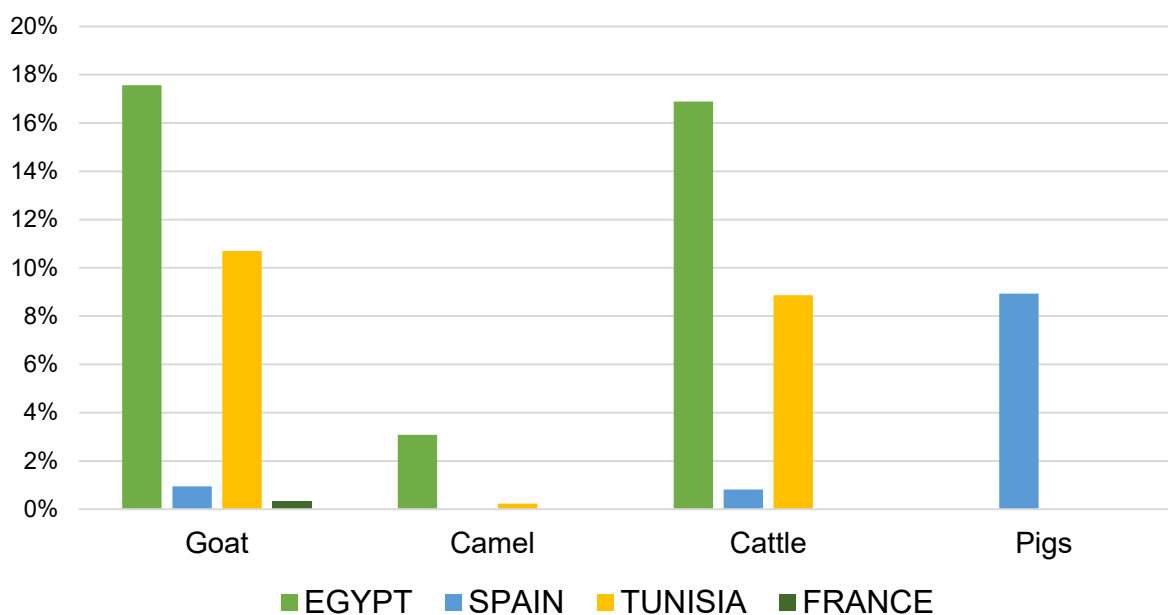
Figure 13. Percentage of the farms that have different species, % Total LU (goat, camel, cattle or pigs) by country.

In Table 37, is showed some indexes that reflect the intensity of the countries, regarding the land use and the labour use. Among countries, the most intensive land use was in Egypt due to the low agricultural size that they have, and regarding the labor use the most labor intensity was presented in Spain with large differences.

Table 37: Results related to the intensity of the small ruminant farms

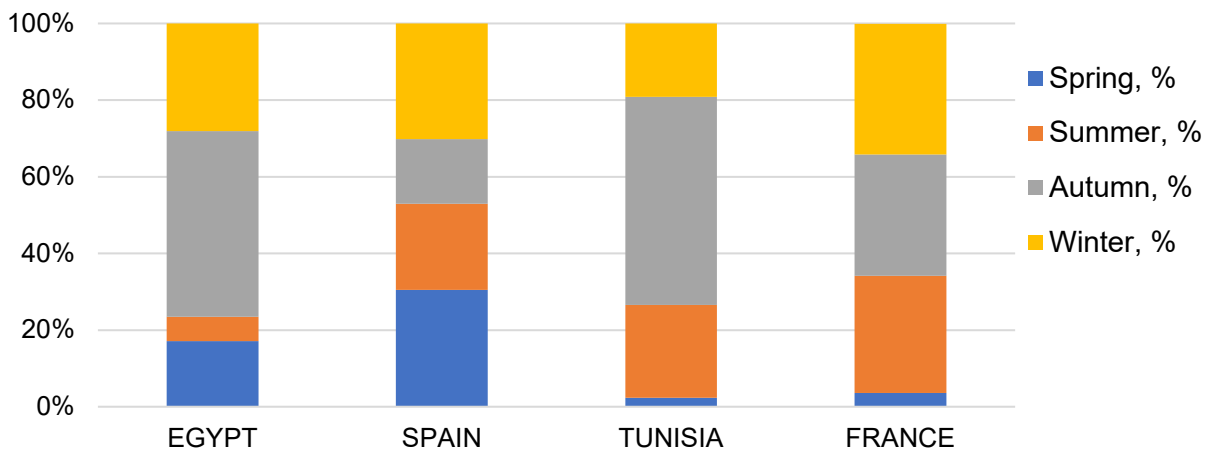| COUNTRY	EGYPT	SPAIN	TUNISIA	FRANCE
Total LU	25.8	295.7	25.0	120.9
Sheep land use[1]	3.9	2.0	0.9	0.6
Sheep land use[2]	2.5	0.6	0.7	0.2
Sheep labour use[3]	5.1	92.3	8.2	51.3
Sheep/goat land use[1]	4.9	2.0	1.0	0.6
Sheep/goat land use[2]	3.2	0.6	0.7	0.2
Sheep/Goat labour use[3]	6.2	93.2	8.9	51.3

[1] Livestock unit/ Utilized Agricultural Area (ha); [2] Livestock unit/total land available (ha); [3] Livestock unit /total work unit

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3.5.4 Reproductive management

Reproductive data by country is presented in Table 38. The main lambing system in Egypt was continuous (81%), in Spain 3 lambing's /2year (76%), in Tunisia continuous (56%) and 1 lambing (24%), and in France 1 lambing/year (94%). Egypt and Tunisia presented the main lambing in autumn, whereas in Spain and in France the lambing's were throughout the year (Figure 14). These values show the greater intensity of Spanish systems comparing with the rest of countries.

Table 38: Results related to reproductive management of Flocks

COUNTRY	EGYPT	SPAIN	TUNISIA	FRANCE
Lambing system, % farms				
Continuous	81%	0%	56%	0%
1 lambing season	2%	0%	24%	94%
1 main+1second	0%	4%	17%	0%
3 lambings/2 years	17%	76%	4%	6%
5 lambings/2 years	0%	20%	0%	0%
Male effect, % farms	40%	72%	33%	NA
Hormonal treatment, % farms	2%	68%	7%	NA
Artificial insemination, % farms	0%	13%	5%	3%
Pregnancy diagnosis, % farms	47%	22%	11%	NA
Age at first lambing, months	16	16	15	19
Lambing season				
Spring, %	17%	30%	2%	4%
Summer, %	6%	22%	24%	31%
Autumn, %	48%	17%	54%	32%
Winter, %	28%	30%	19%	34%

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Figure 14: Lambing season by country.

Regarding reproductive indexes (Figure 15), Spain presented the greatest value of fertility, prolificacy and consequently of productivity. Egypt presented the lowest value of productivity 0.5 lambs sold per ewe /year, this low productivity is due to the high mortality (22%) and the self-consumption of lambs (8%).
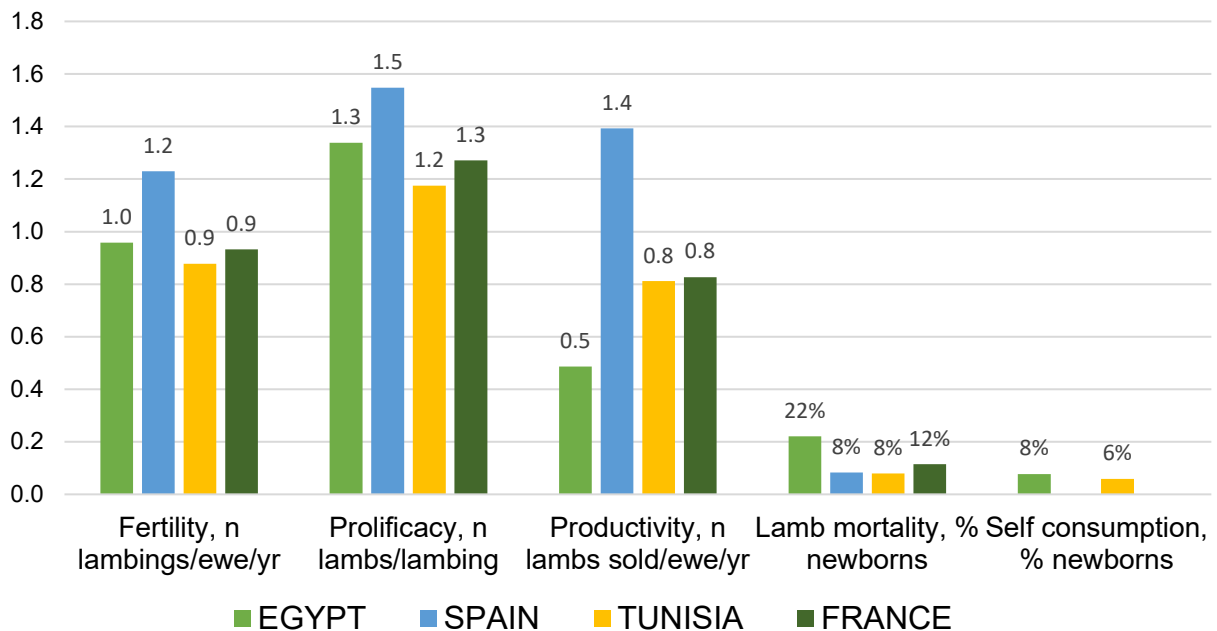
Figure 15. Reproductive index of flocks by country.

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3.5.5 Feeding management

The feeding management of the adult flock reflected important differences between countries, with grazing period going from around 6 to 9 month per year (Table 39). The type of supplement also varied between countries, Egypt and Tunisia offered concentrates supplement, whereas Spain and France used mainly Energy+ Fibre.

Table 39: Results related to feeding management of Flock (adult and lamb) in all four countries

COUNTRY	EGYPT	SPAIN	TUNISIA	FRANCE
Adult flock				
Days on pasture, d	180	243	288	265
dry rangelands, % days	29%	39%	NA	86%
stubble, % days	20%	36%	NA	3%
forage crops, % days	19%	25%	NA	11%
Type of supplement, % farms				
Energy	84%	36%	60%	10%
Fibre	3%	8%	4%	27%
Energy+fibre	13%	56%	36%	63%

The country where the flock spent more time grazing was Tunisia, followed by France, Spain and Egypt (Figure 16).
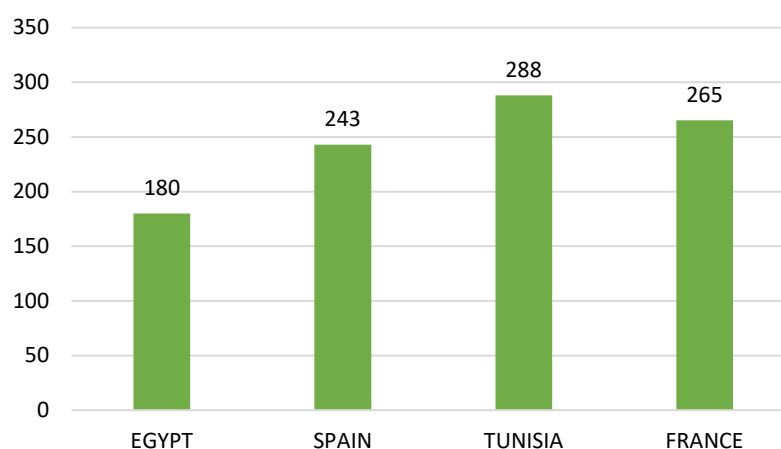
Figure 16. Days of flocks spent grazing in Egypt, Spain. Tunisia, France.

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The lamb feeding management differed between countries (Table 40) with differences among countries. While in Egypt and Tunisia lamb grazed in most of farms, In Spain never grazed and in France only in 22% of farms. The average number of days of lamb grazing varied among countries: in Tunisia lambs grazed 271 days, in Egypt grazed 155 days, in France 82 days and 0 days in Spain (Figure 17).

Table 40: Results related to feeding management of lambs in all four countries

COUNTRY	EGYPT	SPAIN	TUNISIA	FRANCE
Lamb feeding				
Grazed pasture, % farms	100%	0%	85%	22%
days on pasture, d	155	0	271	82
Type of supplement during lactation, % farms				
energy	66%	0%	19%	22%
fibre	18%	0%	16%	9%
Energy+fibre	7%	100%	48%	56%
no supplement	9%	0%	17%	13%
On-farm fattening post weaning, % farms	98%	72%	86%	94%
Type of supplement during fattening, % farms				
energy	56%	0%	12%	NA
fibre	16%	0%	24%	NA
Energy+fibre	28%	100%	63%	NA
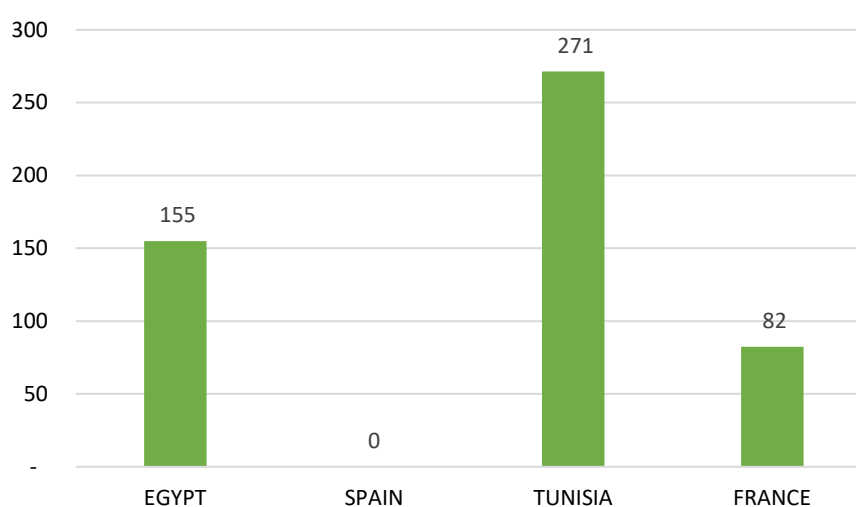
Figure 17: Days of lambs spent on average grazing in Egypt, Spain. Tunisia, France.

3.5.6 Lambs sales

Table 41 shows the data about the lambs' sales by country. In Spain and France, lambs were sold by weight, and although in Tunisia and Egypt was the main criteria, they had also take age into account.

The type of products sold differed among countries, the main product of Egypt, France and Tunisia was the heavy lamb, whereas in Spain was the light lambs.

Table 41: Results related to lamb sale by country

COUNTRY	EGYPT	SPAIN	TUNISIA	FRANCE
Selling criteria, % farms				
weight	46%	100%	61%	100%
age	27%	0%	0%	0%
weight + age	27%	0%	39%	0%
Category, % lambs sold				
Heavy lamb	81%	0%	65%	100%
Light lamb	19%	88%	35%	0%
Suckling lamb	0%	12%	0%	0%
Quality label, % farms	0%	64%	0%	44%

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Annex 1: Survey

Survey herd management

This survey is part of the PRIMA project ADAPT-HERD which is taking place in Egypt, France, Spain, and Tunisia and which general aim is the development of management strategies to improve herd resilience and efficiency by harnessing the adaptive capacities of small ruminant. Specifically, this survey will help to understand farmer views on farm adaptation strategies to climate change in order to inform the design of private strategies and public policies to support said process. This survey will be implemented to farmers in all countries participating in the project.

You should know that your participation is voluntary and that you can change your mind in any moment and withdraw your consent for participating in this study. We will take very few personal data, your name and contact detail, in case we need to contact you for some clarification revering the survey. Your personal data will appear under no circumstances in any result of the survey analysis and nobody external to the project will be able to relate your answer with you. In any case, the treatment of the personal data collected in this survey will follow the Spanish and European laws of personal data protection. According to it, you have the right of accessing, modifying or withdrawing your personal data in any moment. To do so you will have to contact the person responsible of the study, whose data appear in this form.

1. General information

1.1.Date _____

1.2.N survey_____

1.3.Surveyor Name

1.4.Farmer Name   ___

1.5.Age

1.6.Place/locality

1.7.Town

1.8.ID HERD

1.9.Phone

1.10. e-mail_____

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1.11. Descriptive system 1) Intensive ☐   2) Extensive ☐   3) Semi-Extensive ☐ 4) Other ☐

1.12.Type of farm: 1) Family farm (one owner) ☐   2) Family-business farm (owned by several family members) ☐   3) Business farm ☐ 4) Other ☐

2. Surfaces and uses

2.1 Farm area and ownership (Utilized Agricultural Area; UAA)

Hectares	Non-irrigated (ha)	Irrigated (ha)	Total (ha)
2.1.1 Owned	a)	b)	c)
2.1.2 Rented (to private owner)	a)	b)	c)
2.1.4 Other	a)	b)	c)
2.1.5 Total	a)	b)	c)

2.2 Land use

2.2.1 Crops	Non-irrigated (ha)	Irrigated (ha)	Total (ha)
2.2.1.1 Permanent crops (vines, olive trees, almonds trees, etc) _____	a)	b)	c)
2.2.1.2 Cereal crops	a)	b)	c)
2.2.1.2.1 Type 1: ………..…			
2.2.1.2.2 Type 2: ………..…			
2.2.1.3 Fallow	a)	b)	c)
2.2.1.4 Forage crops	a)	b)	c)
2.2.1.4.1 Type 1: ………..…	a)	b)	c)
2.2.1.4.2 Type 2: ………..…	a)	b)	c)

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2.2.1.5 Others	a)	b)	c)

2.2.2 Pastures area	Non-irrigated (ha)	Irrigated (ha)	Total (ha)
2.2.2.1 Grazed	a)	b)	c)
2.2.2.2 Harvested	a)	b)	c)
2.2.2.3 Shrubs and trees	a)	b)	c)
2.2.2.4 Others	a)	b)	c)

2.2.3 Forage, grain and straw production (T)	Non-irrigated (T)	Irrigated (T)	Total (T)
2.2.3.1 Hay	a)	b)	c)
2.2.3.2 Silage	a)	b)	c)
2.2.3.4 Straw	a)	b)	c)
2.2.3.5 Cereal grain	a)	b)	c)
2.2.3.6 Others	a)	b)	c)

2.2.4 Common land	Total (ha)
2.2.4.1 Mountain area	
2.2.4.2 Intermediate areas (municipals, hills near farm…)	
2.2.4.3 Others	

3. FAMILIAR STRUCTURE AND LABOUR

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3.1 Household members: above 65yrs_____65-18yrs_____below 18_____

3.2 Generational turnover: 1) Yes ☐   0) No ☐   2) Don't Know ☐

3.3 Labour in the explotation	Complete dedication (WU)	Partial dedication		
		Months/ year	Hours/ day	Work out of explotation
3.3.1 Owner				
3.3.2 Wife				
3.3.3 Others				

3.4. Contract labour	Complete dedication	Partial dedication	
		Months/ year	Hours/day
3.4.1 Employer 1			
3.4.2 Employer 2			

4. Flock

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4.1 Flock size and composition

4.1.1 Number of ewes	
4.1.2 Number of replacement (Young females that have not reproduce yet)	
4.1.3 Number of rams	
4.1.4 BW ewes (kg)	

4.2 Breeds

Breed name	Number of ewes	Number of Rams	Number of Replacement ewes
4.2.1 Breed 1	a)	b)	c)
4.2.2 Breed 2	a)	b)	c)
4.2.3 Breed 3	a)	b)	c)

4.3 Are you member of breed association?   No ☐   Yes ☐

4.4 Do you provide genealogy data to the breeding programmes? No ☐   Yes ☐

4.5 Do you provide animal performance data to the breeding programmes? No ☐   Yes ☐

4.6 Have you genotyped some of your animals? No ☐   Yes ☐

4.7. Others livestock species	Number of ewes	Number of Rams	Number of replacement (Young females that have not reproduce yet)
4.7.1 Goat	a)	b)	c)
4.7.2 Other:	a)	b)	c)

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4.8 Flock replacement

4.8.1 Females: 1) Own ☐   2) own and bought ☐ 3) Bought ☐

       % of replacement females bought_____

4.8.2 Males: 1) Own ☐   2) own and bought ☐   3) Bought ☐

       % of replacement males bought_____

5. Reproduction and lamb management

5.1 Mating system

Continuos mating	a)	3 lambing in 2 years	d)
1 lambing/ 1 year	b)	5 lambing in 3 years	e)
1 lambing + return mating	c)	Other……………	f)

5.1.1 Do you divided the flock in bathes? Yes ☐   No ☐

If yes; how many bathes do you do?.................................

5.1.2 Do you know the mating success?...........................

5.2 Do you use male effect?   Yes ☐   No ☐

5.3 Do you use "flushing" effect?   Yes ☐   No ☐

5.4 Do you use hormonal treatments?   a) Yes ☐   b) No ☐ c) When? _____

           d)   Which treatment? _____

5.5 Do you do pregnancy diagnostic?   Yes ☐ No ☐

5.6 Do you use artificial insemination?   a)   Yes ☐ b) No ☐ c) Rate of inseminated ewes per year _____

5.7 Average age at the first lambing _____

5.8

5.8 Lambing calendar (%)(ask n and then calculate %)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lambing	a)	b)	c)	d)	e)	f)	g)	h)	i)	j)	k)	l)

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5.9 Reproductive indexes (per year)[1]

5.9.1 Lambing n		5.9.9 Lambs dead (< 1 week)	
5.9.2 Dead ewes		5.9.10 Lambs dead before weaning	
5.9.3 Empty ewes		5.9.11 Lambs dead after weaning	
5.9.4 Abortions		5.9.12 Lambs fattening in farm	
5.9 5 Double lambing		5.9.13 Replacement	
5.9.6 Triple lambing		5.9.14 Self-consumpiton	
5.9.7 Total of lambs born		5.9.15 Lambs sold	
5.9.8 Num lambing/ewe/year		5.9.16 Lambs sold/ewe/year	

[1] we need: prolificity, fertility, % mortality, number of lambs sold, replacement.

5.10 Lamb data[2]

5.10.1 Birth weight (kg)		5.10.5 Slaughter weight (kg)	
5.10.2 Weaning age (month)		5.10.6 Carcass weight (kg)	
5.10.3 Weaning weight		5.10.7 Slaughter place	
5.10.4 Slaughter age (month)		5.10.8 Commercialisation place	

[2] The farmer was not able to give us this information

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6. FEEDING MANAGEMENT

6.1 Rations of ewes:

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Period												
Ewes N												
Lot												
Grazing Pasture type												
Supplementation Type Forage/concentrate												
Period												
Ewes N												
Lot												

Grazing Pasture type												
Supplementation Type Forage/concentrate												

6.2 Rations of RAMS

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Period												
RAMS N												
Grazing Pasture type												
Supplementation Type Forage/concentrate												

6.3 Rations of lambs

6.3.1. Feeding until weaning: a) milk ☐   b) concentrate ☐   c) forage☐

6.3.2. Fattening in farm: Yes ☐ No ☐

6.3.3. Feeding post-weaning: a)straw ☐   b)forage ☐   c)cereal ☐   d)concentrates ☐

      a)Kg/lamb_____   b)kg_____   c) kg_____d) kg_____

6.3.4 Feed origin: a) Own ☐   b) Bought ☐   c) Both ☐, % of own…………

6.3.5 Forage type: a) Hay ☐   b) Silage ☐   c) Grazing ☐

6.3.6 Grazing   a) Crops ☐ %....   b) Pastures ☐ %.......   c) Common lands ☐ %......

   6.3.7 Days of grazing_____

6.3.8 Fattened lambs selling criteria: a) Weight ☐ _____b) Age ☐ _____

7. Marketing of products

	Category	Number	Price Euros/animal	Buyer/Client (Burcher, farmer, cooperative, consumer…)
7.1 Lambs	a)	b)	c)	d)
7.2 Culling ewes		a)	b)	c)
7.3 Replacement ewes		a)	b)	c)
7.4 Rams		a)	b)	c)
7.5 Milk (kg milk/year)		a)	b)	c)
7.6 Cheese		a)	b)	c)
7.7 Wool		a)	b)	c)
7.8 Others		a)	b)	c)

7.9 Do you commercialize your product under a GPI, PDO, or any other quality label?   No ☐   Yes ☐
%_____

7.9.1 If yes, How many lambs sold in the GPI _____